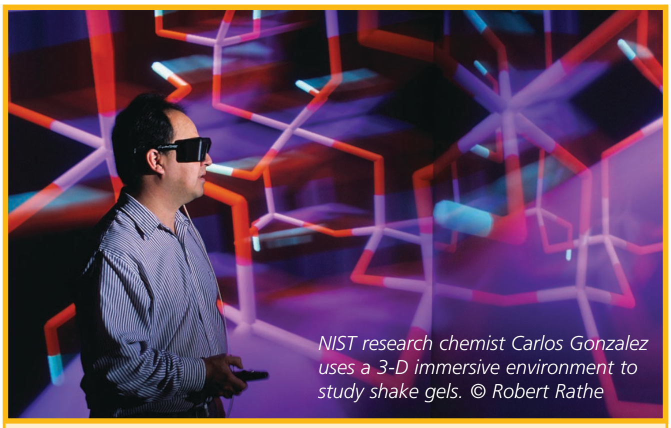

NIST research chemist Carlos Gonzalez uses a 3-D immersive environment to study shake gels. © Robert Rathe

Chemists and computer scientists are using a special facility at the US National Institute of Standards and Technology to scale molecules up for people-sized interactions.
Using chemical data, NIST software, special eyewear, and floor-to-ceiling display screens, they create giant 3D molecules that move and whose behavior can be seen and understood in minutes.
The 3D facility has been used to study 'smart' gels, inexpensive material that expands or contract in response to external stimuli. Applications may include medical, exotic foods, cosmetics or sensors. But a better understanding of the molecular behavior of the gels is needed before before they can be optimised.
Shake gels are mixtures of clays and polymers that firm up into gels when shaken, and then gradually relax again to liquids. The visualization facility helped scientists see that it is the polymer's oxygen atoms, not the hydrogen atoms as previously thought, that attach to the clay.
Theoretical calculations also show that water binds to the clay surfaces in a perpendicular arrangement. This may help create the firmness of the gel.
The study technique may have value in other material analysis situations.

Atomic Layer Deposition research

ASM International NV is to enter into a long-term co-operative agreement with the University of Helsinki to jointly pursue further development of Atomic Layer Deposition (ALD) technology. As part of this agreement, ASM intends to relocate its Espoo, Finland, research and development activities to the nearby campus of the University of Helsinki, Finland.

Atomic Layer Deposition deposits single atomic layers on semiconductor wafers one at a time at low temperatures. The process is used to create ultra-thin films of exceptional quality and flatness. Through its Microchemistry subsidiary, ASM has pioneered development of ALD applications for semiconductors. The University of Helsinki is a leading research institute active in ALD.

Simultaneously ASM has moved to locate substantially all operations of its Polygon ALCVD product-line to the US. This will shrink the Finnish subsidiary by about 25 people, in ASM's front-end operations restructuring.

The co-operation will allow ASM and the University to combine forces on ALD research, and develop very advanced ALD processes. Markku Leskela, Professor of Inorganic Chemistry at the University of Helsinki said that while regretting the reduction in size, ASM Microchemistry's nearly doubling of "...ALD researchers and reactors in our premises is a great opportunity for a fruitful co-operation. We can now do everything from precursor design to initial manufacturing scale-up, which will increase speed and chances of technology adoption in the industry."

Si nanolitho uses self-assembly

Nanoscale patterning of silicon substrates with regular, repeatable, atomically perfect application-specific templates could enable manufacturable nano scale chips in a decade, say scientists at the Materials Research Science & Engineering Center, University of Wisconsin.

Despite nanoscale components as single-electron transistors to quantum dots, casting them in chips is still uncertain. Weak point is irregularity. The lab aims to show that curing this would lead to manufacturability. Work is done in cooperation with the consortium Semiconductor Research Corp, including AMD, IBM, Intel & Motorola. The team has used block co-polymers that 'self-assemble like snowflakes,' to enable nanoscale patterns to form only in designated areas on a chip.

Effectively a nanoscale mask is formed on the substrate, similar to conventional lithography.

Future silicon substrates could not only host arrays of identical molecular-size components, but take advantage of conducting polymers to interconnect components with nanoscale wiring.

By chemically altering a conventional silicon wafer surface, researchers used extreme-UV light to lay down straight, parallel lines of alternating chemicals as close as 20nm apart. Washing with a solution of the block co-polymer, the team masked out parallel lines, a technique delivering registration and overlay.

"This kind of hybrid technology can integrate self-assembling materials, such as block co-polymers, into existing manufacturing processes, such as lithography, and deliver molecular-level control." says team leader Paul Nealey. "Now we hope that semiconductor manufacturers will adopt our techniques to build real nanoscale chips."

Next the group hopes to criss-cross lines to create nanoscale domains for ultradense memory arrays of nano devices such as quantum dots.

NIST nano measurements

A research team at the National Institute of Standards and Technology in Gaithersburg, MD, have created two new technologies. The first measures distances smaller than the radius of an atom. The second is how to make a super-small ruler.

The nanoscale standard unit of measurement is based on the spacing of atoms in a perfectly ordered crystal. Rick Silver heads the NIST 'Atom-Based Artifacts Project.'

Using the nano-sized scale of measurement and a scanning tunnelling microscope the project team was able to write patterns on durable, silicon-based materials. The patterns have 10nm linewidths, equivalent to about 30 silicon atoms across.

Industry could use these measured patterns like a ruler as a benchmark to calibrate tools used in research and production. Patterns are long-lived. Work suggests reactive ion etching can increase their 3D relief.

Silver's team also developed a diode-laser based interferometer that determines the distance between two objects on the basis of light interference patterns. The team has measured distances smaller than 10pm, or less than one-hundredth of a nanometre, with the device, Silver said.